Official

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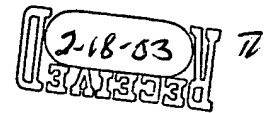## IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Applicant: Shuo-Yen Robert Li

Case: 15

Serial No. 09/882,139

Filed: June 15, 2001

Group Art Unit: 2663

Examiner: Chau T. Nguyen

Title of Invention: **A CONDITIONALLY NONBLOCING SWITCH OF THE CIRCULAR EXPANDER TYPE**

THE COMMISSIONER OF PATENTS AND TRADEMARKS
WASHINGTON, D.C. 20231

SIR:

      Enclosed is a <u>supplement</u> to the Preliminary Amendment, dated September 12, 2001, in the above-identified application. This supplement is in Response to a Notice of Non-Compliant Amendment (37CFR 1.121) dated March 3, 2003. This Notice required a marked-up version of the replacement pages 8 and 9 included in the Preliminary Amendment -- marked-up pages 8 and 9 are enclosed, starting with page 12 and ending with page 15 to be considered as appended to the Preliminary Amendment.

                                    Respectfully submitted,

Date: 2 - 18 - 03

                                John T. Peoples (Reg. No. 28,250)
                                14 Blue Jay Ct.
                                Warren, NJ 07059
                                (908) 580-9816

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Date of Certificate   John T. Peoples

-1-

Pages 8 and 9 were changed as follows ([denotes the beginning and] denotes the

end of removed words, and underline denotes the addition of words):

SUMMARY OF THE INVENTION

The shortcomings of the prior art, as well as other limitations and

deficiencies, are obviated in accordance with the present invention by applying algebraic

principles to the physical realization of a large switching fabric based upon contemporary

technologies.

[In accordance with a broad system aspect of the present invention, an

N×N circular expander for serving a connection request to route k incoming signals, k≤N,

and for enabling conditionally nonblocking switching, includes: (a) a switch defined by a

set of connection states and having an array of N input ports with N distinct input

addresses and an array of N output ports with N distinct output addresses wherein the k

incoming signals arrive at k distinct input ports determining k active input addresses and

are destined for corresponding k distinct output ports determining k active output

addresses, the switch accommodating every combination of concurrent connections,

point-to-point or multicast, subject to the following constraint: if the input ports i and j

are connected to the output ports p and q, respectively, then $\|i-j\|_N \le |p-q|$, where $\|i-j\|_N =$

$\min \{|i-j|, N-|i-j|\}$ is the distance between i and j on the discretized circle size N; and (b)

control circuitry, coupled to the switch, for routing the incoming signals from the k

distinct input ports to the corresponding k distinct output ports by activating one of the

connection states such that the activated one of the connection states accommodates the

connection request.

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In accordance with a broad method aspect of the present invention, a method for constructing an N×N circular expander to serve a connection request to route k incoming signals, k≤N, includes: (a) configuring a switch defined by a set of connection states and having an array of N input ports with N distinct input addresses and an array of N output ports with N distinct output addresses wherein the k incoming signals arrive at k distinct input ports determining k active input addresses and are destined for corresponding k distinct output ports determining k active output addresses, the switch accommodating every combination of concurrent connections, point-to-point or multicast, subject to the following constraint: if the input ports i and j are connected to the output ports p and q, respectively, then $\|i-j\|_N \le |p-q|$, where $\|i-j\|_N = \min \{|i-j|,$ $N-|i-j|\}$ is the distance between i and j on the discretized circle size N; and (b) routing the incoming signals from the k distinct input ports to the corresponding k distinct output ports by activating one of the connection states such that the activated one of the connection states accommodates the connection request.]

In accordance with a broad method aspect of the present invention, a method for implementing a class of N×N circular expanders each serving a connection request to route m incoming signals, m≤N, and for enabling the service of any connection request in a nonblocking way on the condition that the connection request is compliant to certain constraints, the method for each of the circular expanders includes: (a) configuring a switch defined by a set of connection states and having an array of N input ports with N distinct input addresses 0, 1, ... , N−1 and an array of N output ports with N

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distinct output addresses $0, 1, \ldots, N-1$ wherein the m incoming signals arrive at m input ports determining m active input addresses and are destined for a total of n, $m \leq n \leq N$, distinct output ports determining n active output addresses, and wherein said constraints on the connection request are that: for any two active input addresses i and j and any two active output addresses p and q such that i is being connected to p and j is being connected to q, $\|i-j\|_N \leq |p-q|$, where $\|i-j\|_N = \min \{|i-j|, N-|i-j|\}$ is the distance between i and j on the discrete circle of length N; and (b) routing the incoming signals from said m input ports to said n distinct output ports by activating one of the connection states such that the activated one of the connection states accommodates the connection request subject to said constraints on the connection request, said class excluding (i) those having a switch constructed from the banyan network of expander cells prepended with the shuffle exchange and (ii) those having a switch constructed from the shuffle-exchange network of expander cells prepended with the shuffle exchange.

In accordance with a broad system aspect of the present invention, a class of $N \times N$ circular expanders each serving a connection request to route m incoming signals, $m \leq N$, and for enabling the service of any connection request in a nonblocking way on the condition that the connection request is compliant to certain constraints, each of the circular expanders includes: (a) a switch defined by a set of connection states and having an array of N input ports with N distinct input addresses $0, 1, \ldots, N-1$ and an array of N output ports with N distinct output addresses $0, 1, \ldots, N-1$ wherein the m incoming signals arrive at m input ports determining m active input addresses and are destined for a total of n, $m \leq n \leq N$, distinct output ports determining n active output addresses, and

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wherein said constraints on the connection request are that: for any two active input

addresses i and j and any two active output addresses p and q such that i is being

connected to p and j is being connected to q,$\|i-j\|_N \leq |p-q|$, where $\|i-j\|_N = \min \{|i-j|,$

$N-|i-j|\}$ is the distance between i and j on the discrete circle of length N; and (b) control

circuitry, coupled to the switch, for routing the incoming signals from said m input ports

to said n distinct output ports by activating one of the connection states such that the

activated one of the connection states accommodates the connection request subject to

said constraints on the connection request, said class excluding (i) those having a switch

constructed from the banyan network of expander cells prepended with the shuffle

exchange and (ii) those having a switch constructed from the shuffle-exchange network

of expander cells prepended with the shuffle exchange.

FAX COVER SHEET

Date: February 18, 2003   Pages: 6 (including this page)

Name: Examiner Chau T. Nguyen
       Art Unit 2663

The United States Patent and Trademark Office

Tel. No. 703-308-5340
"Before Final" Fax No. 703-872-9314

From: John T. Peoples

Tel. No. 908-580-9816
Fax No. 908-580-9817

Attached is an Amendment in Response to
Notice of Non-Compliant Amendment of March 3, 2003

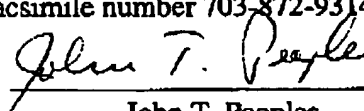Applicant: **Shuo-Yen Robert Li**

Application No.: **09/882,139**

Filed: **June 15, 2001**

Group Art Unit: **2663**

Examiner: **Chau T. Nguyen**

Title of Invention: **A CONDITIONALLY NONBLOCING SWITCH OF THE**
                        CIRCULAR EXPANDER TYPE

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